DOCUMENT RESUME

ED 082 966 SE 015 988

AUTHOR	Dieter, Donn L.
TITLE	Teacher Evaluation: A Strategy for Science Teachers.
PUB DATE	Nov 72
NOTE	20p.; Paper presented at the annual meeting of the North Carolina Science Teachers Association (4th, Asheville, Novemeber 1972)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Educational Research; *Evaluation Criteria; Evaluation Methods; *Evaluation Techniques; *Occupations; Science Teachers; Teacher Attitudes; *Teacher Evaluation
IDENTIFIERS	Research Reports

ABSTRACT

Reported is a study on the process of teacher evaluation intended to establish evaluation procedures acceptable to science teachers. A questionnaire of 111 items was used to set criteria. Each of the 220 judges involved in the 1970 Outstanding Biology Teacher Award program was asked to rate the items. The category with the majority of significant items concerned the relationships pertaining to the teacher-student-subject and -classroom utilization. The judges' occupations were analyzed into seven distinct groups. Results obtained indicated the presence of biases due to judges' occupational status. Recommendations were made on the teacher participation in the evaluation process, selection of judges through teachers' suggestions, and permission of teachers' expression of opposing ideas about judgments. Included is a table of differently rated factors. (CC)

FILMED FROM BEST AVAILABLE COPY

ED 082966

U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Teacher Evaluation:
A Strategy for Science Teachers

Paper
Presented at the
Fourth Annual Meeting
North Carolina Science Teachers Association
Asheville
November 1972

Dr. Donn L. Dieter
Division of Development
North Carolina of Public Instruction
Raleigh, North Carolina

SE 015 988

Background

In passing Chapter 833 of the 1971 Session Laws, the North Carolina General Assembly established rather elaborate and formal procedures for the retention and termination of public school personnel. Known variously as the "Fair Employment and Dismissal Act" and "The North Carolina Teacher Tenure Act," and codified as GS-115-142, the Act became effective July 1, 1972.

Although the Act lists "inadequate performance" as one of the grounds for dismissal of the teacher, and is quite specific in describing the procedures to be followed, it does not describe the kinds of performance which might be considered "adequate" by those who evaluate.

It is not the intent of this paper to suggest that legislators should address themselves to this question or that legislation be enacted which spells out acceptable teacher behavior. Rather, it is intended to present some of the current problems of teacher evaluation, and to suggest some ways that science teachers can interact with others in their schools to establish evaluation procedures which are relevant and acceptable to them.

Problems of Teacher Evaluation

Problems of evaluation are neither new or confined to science teaching. Although it has been one of the most researched areas in the field of education, (Biddle and Ellena, 1964, p. v.; Bradley et al, 1964, p. 7), and in spite of the fact that a variety of approaches to study the topic have been devised, efforts to find suitable methods for evaluating teacher competence and teacher effectiveness have been quite disappointing.

Evaluation of teachers is an accepted and expected aspect of the educational profession with various individuals and groups claiming the right to be

involved. (NEA, 1969.) Included are persons such as school administrators and supervisors, groups such as the National Education Association, local and state teachers' associations, and various professional teaching organizations such as the National Association of Biology Teachers.

Recent studies of teacher evaluation indicate that there is much concern about such aspects as the criteria which might be applied, about who should do the evaluating, and about the subjective effects introduced into the process due to the personal bias of the judges involved. (Daniel, 1967, p. 97; Lopez, 1970, pp. 231-37.) Other concerns have been expressed about the lack of established standards suitable for measurement; the problems of separating assessment of teaching from assessment of the teacher; the disagreement by investigators over the terms used to describe competence or effectiveness and over the interpretation of findings. (Lopez, 1970, pp. 231-32; Bolton, 1971, pp. 2-3; Musella, 1970, pp. 18-49.)

Regarding the problem of identifying suitable criteria which might be utilized, a number of studies have resulted in the development of lists of such criteria. Although they vary in emphasis, these can be grouped into several categories and include: criteria related to a teacher's competency in subject matter; his effectiveness with various instructional materials and techniques; the personal activities leading to professional growth and accomplishments; and some criteria which relate to a teacher's intrinsic personal traits. (NEA, 1969; Daniel, 1967, pp. 22-23; Bradley, 1964, pp. 71-76; Raths, 1967, pp. 8-9.)

Another serious concern relates to the question of who is competent to judge. Although it appears to be not unusual for a single person such as a principal or supervisor to be solely responsible for evaluating the teacher, the literature

suggests that evaluation should be a cooperative effort and that teachers should be evaluated by a team of persons to permit a variety of special interests and value systems to be represented.

Several studies indicate that because of the distinct, unique, personal biases which exist within each individual judge, it does not appear possible to be either "objective," "impartial," or "fair" in any teacher evaluation process. Because of these biases, one should not assume that there is a single set of educational objectives but should instead expect as many different evaluation outcomes as there are different views represented. (Cohen and Brawer, 1969, p. 7; Cicirelli, 1969, p. 375; Brown, 1969, pp. 59-95; Ryans, 1960, p. 16.) Thus, by using a team, it is felt that a broader base of competencies can be evaluated and that a more satisfactory evaluation will result than is possible from a single judge. (Cohen and Brawer, 1969, p. 8; Conant, 1963, p. 62.)

Evaluation of Science Teachers

How do these concerns relate to science teachers? Are they usually evaluated differently from other teachers? What criteria are applied to them? Do different judges evaluate science teachers differently?

Apparently, few studies have been made of the evaluation of science teachers. (Tannenbaum, 1964; Vanhouten, 1965; Woodard, 1963.) However, even though few comprehensive studies are found, one group, the National Association of Biology Teachers, for about a decade has been quite actively engaged in a well-organized and formal program of teacher evaluation. (Klinge, 1965, 748; Yager, 1964, pp. 192-93.) In this program, the Outstanding Biology Teacher Award program (OBTA), a teacher from each state is selected as an "Outstanding Biology Teacher" each year. Procedures require that individual state selection committees be formed to

evaluate individual candidates for the award, and although the composition of each state selection committee is varied, they usually consist of persons representing a variety of occupations such as secondary school teachers, administrators, science supervisors, college and industrial biologists, and professors of science education.

In a study to gain some understandings of this evaluation process (Dieter, 1972), each of the two-hundred-twenty judges of the 1970 Outstanding Biology Teacher Award program was asked to rate the various criteria he employed when evaluating candidates for the award. Ratings were analyzed to determine significance, and the study attempted to find answers to the following questions:

1. Who are these judges of biology teachers: What variety of occupational and/or education positions do they represent?
2. What criteria do they employ in the evaluation process? Are some criteria of more value to some judges than others?
3. Does the occupational status of a judge relate to the way he evaluates a biology teacher? If so, in what ways?

From the related literature and materials available from the Association, and incorporating suggestions from a review panel, a questionnaire containing one-hundred-eleven items which might be used as criteria when evaluating biology teachers was developed and sent to committee members to be rated according to their value to them when used for the evaluation of candidates for the OBTA award. Items in the questionnaire included those derived from:

- the comments by those who nominated or recommended the teacher
- the academic qualifications of the teacher

- the teaching and other experiences of the teacher
- the professional activities and accomplishments of the teacher
- the relationships of the teacher to his school and community
- the interrelationships which existed between the teacher, his students, the subject, and classroom organization.

Data Analysis

The Study Group. From data derived from the one-hundred-seventy-nine questionnaires which were returned, seven distinct occupational groups of judges were found (Table 1). These included:

Table 1

Occupational Groups Represented in the 1970 OBTA State Selection Committees

	Number on Committees	Number of Replies
1. College Biologists	56	50
2. Secondary School Teachers	58	41
3. College Professors of Science Education	28	25
4. State Science Supervisors	21	18
5. Secondary School Administrators	17	16
6. Industrial Biologists	21	13
7. Local Science Supervisors	15	12
8. Others: Dentists	2	2
Director, Outdoor Education	1	1
Graduate Student, Education	1	1
TOTAL	220	179

Criteria Found Significant in the Evaluation of Biology Teachers. Of the one-hundred-eleven items suggested as criteria, twenty-one were found to be rated significantly high by the total group of judges. Listed in order of chi-square significance (Table 2), these included:

Table 2

Significant Criteria Employed by Members of 1970 Selection Committees in Making Decisions About Candidates for the OBTA Award

Item	Significance
Interest and enthusiasm for biology	.001
Ability to encourage self-motivation in students	.001
Concerns for student understandings of essential concepts	.01
Ability to inspire self-confidence in students	.01
Concerns for student understandings of essential science processes	.01
Evidences of resourcefulness	.01
Adequacy of self-concept	.01
Concerns for personal involvement of students in learning activities	.01
Evidences of ingenuity	.01
Emotional poise and self-confidence	.05
Evidences of creativity	.05
Apparent interest in self-improvement	.05
Habits of dress, voice, mannerisms, speech	.05
Activities and accomplishments of students	.05
Provisions for differing student interest and abilities	.05
Laboratory experiences characterized by thought-provoking problems	.05
Efforts to encourage student development of hypotheses and theories	.05
Favorable perceptions by students and parents	.05
Facilitates worthwhile student interaction	.05
Ability to develop a classroom climate conducive to learning	.05
Perceptions of individual student needs	.05

It was interesting to find that out of the one-hundred-eleven suggested items, none of the items derived from the comments of those who nominate or recommend candidates, none of the items related to the teacher's academic qualifications, none of the items related to the teacher's relationships to his school and community were rated significantly high by these judges. Only one item was found to be significant in the category related to the candidates professional activities and accomplishments, and that item derived from the activities and accomplishments of students.

Factors found to be not significant included those related to the number and kinds of academic courses taken in college, grades received or degrees held, location or size of college or school, years of teaching experience, managerial efficiency, participation in school, community or professional organizations or activities, publications made, honors or awards received, and the appearance of classroom and laboratory.

The category having the majority of significant items concerned the inter-relationships pertaining to the teacher-student-subject and -classroom utilization. Twenty out of the twenty-one items rated significantly high were found here.

Analysis of the twenty-one items found to be rated significantly high, showed that another classification could be made, and that specific criteria could be grouped as follows:

1. <u>Items related to the teachers' intrinsic personal traits</u>

   Interest and enthusiasm for biology
   Evidences of resourcefulness
   Adequacy of self-concept
   Evidences of ingenuity
   Emotional poise and self-confidence
   Evidences of creativity
   Apparent interest in self-improvement

2. Items related to teacher-student interrelationships

Ability to encourage self-motivation in students
Ability to inspire self-confidence in students
Concerns for personal involvement of students in learning activities
Favorable perceptions by students and parents
Facilitates worthwhile student interaction
Perceptions of individual student needs
Provisions for differing student interests and needs
Efforts to encourage student development of hypotheses and theories

3. Items related to concerns for skills and proficiencies as a science teacher

Concerns for student understandings of essential concepts
Concerns for student understandings of essential science processes
Skill in use of a variety of materials and methods
Activities and accomplishments of students
Laboratory experiences characterized by thought-provoking problems
Ability to develop a classroom climate conducive to learning

Evidences of Evaluator Bias. As indicated, part of the study was to determine if evidences of bias on the part of judges who belonged to different occupational groups could be found. Analysis of data revealed that of the twenty-one items found to have been rated significantly high, eight were found to have been rated significantly different between different judge-groups, indicating evidence of bias. How each judge-group rated these eight items is found in Table 3. An item-by-item analysis follows:

1. Apparent Interest in Self-Improvement. Although the majority of each of the seven judge-groups rated this item as usually or always important, only three-fourths of the Public School Science Supervisors group considered it so. This contrasted with over 97 percent of the Secondary School Teacher group and all

of the Industrial Biologists. Over 16 percent of the Public School Science Supervisors group responding to this item and over 6 percent of the College Biologist group considered it rarely important.

2. Interest and Enthusiasm for Biology. Over 8 percent of the Public School Science Supervisors responding felt this item to be rarely important and 6 percent of the College Biologists rated it rarely or not important. Although more than half of all groups rated it as either usually or always important, all of the Public School Administrators, all of the Industrial Biologists, and all of the Professors of Science Education responding considered it usually or always important to them.

3. Concerns for Student Understandings of Essential Concepts. Although all the Public School Administrators and over 95 percent of the Professors of Science Education responding to this item rated it usually or always important, only about 72 percent of the State Science Supervisors and 58 percent of the Public School Science Supervisors rated it high. In fact, over 16 percent of the Public School Science Supervisors and approximately 8 percent of the College Biologists responding to this item considered it rarely important.

4. Concerns for Student Understandings of Essential Science Processes. Although the majority of all groups considered this item to be usually or always important, differences existed between some groups. In this instance, all of the Professors of Science Education rated it high, while only 58.4 percent of the Public School Science Supervisors rated it thus. Almost 17 percent of the latter group considered this item to be rarely important.

5. Ability to Inspire Self-Confidence in Students. Responses to this item were fairly diverse and ranged from 100 percent of responses as either usually-to-always important for the State Science Supervisor group, to only 50 percent of the Public School Administrators rating it high. Several respondents rated the item either rarely important or not important to them in the evaluation process.

6. Activities and Accomplishments of Students. Analysis of data for this item revealed that although all of the Public School Administrators and Industrial Biologists

rated it either usually or always important, this feeling was not shared by several of the other groups. In fact, only about 47 percent of the Secondary School Teachers and a little less than 60 percent of the Public School Science Supervisors and College Biologists rated it high.

Of significance were the responses which rated this item as rarely important or not important. These included Secondary School Teachers with 12.5 percent, Public School Science Supervisors with 16.7 percent, College Biologists with 10.7 percent, and Professors of Science Education with 8.3 percent.

7. Emotional Poise and Self-Confidence. Analysis of the data for this group revealed that of those responding to the item as an item of importance to them, all judges in the Industrial Biologists group rated it either usually or always important. This contrasted with Public School Science Supervisors and State Science Supervisors whose responses in these categories amounted to about 65 percent each. Also, 17.7 percent of the Public School Science Supervisors and 10.9 percent of the College Biologists thought this trait to be rarely important to them.

8. Adequacy of Self-Concept. Contrasts between the ratings assigned by various judge-groups were particularly noticeable for this item. Even though the majority of all groups rated this item high as usually or always important, 25 percent of the Public School Science Supervisors considered adequacy of the teacher's self-concept to be rarely important, along with more than 12 percent of the Public School Administrators. Only approximately 50 percent of the College Biologists rated the item high.

Discussion and Recommendations

Throughout the course of the study, the intent was to discover something about the evaluation of teachers and not to evaluate the various aspects of the Outstanding Biology Teacher Award program. The program was used because it offered an excellent opportunity to collect data about teacher evaluation on an unusually comprehensive scale. Further, it seemed to adequately provide for the concerns

expressed in the literature about variety in the expectations of judges and for deriving the criteria which they might employ when evaluating teachers. The investigator does not wish his conclusions to be interpreted as judgments of the program, although he is impressed with it as a model for teacher evaluation by a professional group.

The study attempted: (1) to establish the criteria that members of the Outstanding Biology Teacher Award program evaluation teams used when evaluating biology teachers; (2) to identify the various types of their occupations; (3) to establish whether or not specific criteria were valued significantly different; and (4) to determine if occupational status of judges was significantly related to the way they rated specific criteria.

As a result of this study of biology teachers it was possible to make the following conclusions about their evaluation:

(1) Not all criteria used in the evaluation process were important or significant to these judges. Although apparently comprehensive in scope and representative of criteria which are often applied in teacher evaluation, better than 80% were not significant to an acceptable statistical degree. Criteria of low significance included those related to the teachers managerial efficiency, the appearance of the classroom or laboratory, and the teachers participation in school-related, community or professional activities. Of the criteria of greatest importance, almost all were derived from the relationships of the teacher to his subject matter, his skills

in developing science concepts and processes and from his inter-personal relationships with students.

(2) Judges of teachers are biased, with different judges favoring some kinds of criteria over others. Apparently, the occupational status of a judge, i.e., science supervisor, principal, fellow teacher, etc., does affect his use of specific criteria when making decisions about a teachers worth. This is especially noted for those criteria which relate to the teachers apparent interest in self-improvement, their interest and enthusiasm for the subject (biology), their concerns about student understandings of essential science concepts and processes, the teachers ability to inspire self-confidence in students, student activities and accomplishments, and the teachers emotional poise, self-confidence and adequacy of self-concept.

What recommendations can be made as a result of this study? Can the findings about the evaluation of biology teachers be applied to science teachers generally? If so, the following recommendations might be made:

(1) As the person likely to be most knowledgeable in the school about those aspects of teaching which concern him, the science teacher should be actively involved in the evaluation process and should be permitted to participate in decisions about the criteria to be applied to him. If, as found in this study, not all criteria usually used are significant, the science

teacher should point this out to his judges, and should suggest those which he feels are significant (Table 2).

(2) Because it is apparent that the occupational status of a judge does bias evaluation outcomes, and because it seems desirable to have a broad base of outlooks represented, it is suggested that the science teacher have opportunity to suggest those persons he feels are suitable to serve as members of his evaluation team.

(3) If the teacher has not been permitted to either establish acceptable criteria or to assist in the selection of his evaluators, and if he feels he has been unfairly judged, the teacher can present a statement of the particulars of his objections and explanations for inclusion in his personnel file. The Act provides for such statements and encourages teachers to take this action if it is felt necessary.

Table 3

FACTORS FOUND TO BE RATED SIGNIFICANTLY DIFFERENT FOR EVALUATING BIOLOGY TEACHERS, LISTED BY INDIVIDUAL JUDGE-GROUPS

Item	Percent		
	Usually Important	Always Important	Total
SECONDARY-SCHOOL TEACHERS			
Apparent interest in self-improvement	36.6	61.0	97.6
Interest and enthusiasm for biology	29.3	68.3	97.6
Concerns for student understandings of essential science processes	34.1	58.5	92.6
Concerns for student understandings of essential concepts	29.3	61.0	90.3
Emotional poise and self-confidence	40.5	48.6	89.1
Ability to inspire self-confidence in students	35.9	51.3	87.2
Adequacy of self-concept	44.4	22.2	66.6
Activities and accomplishments of students	32.5	15.0	47.5
PUBLIC SCHOOL ADMINISTRATORS			
Concerns for student understandings of essential concepts	37.5	62.5	100.0
Interest and enthusiasm for biology	31.3	68.8	100.0
Activities and accomplishments of students	68.8	31.3	100.0
Concerns for student understandings of essential science processes	50.0	43.8	93.8
Apparent interest in self-improvement	37.5	56.3	93.8
Ability to inspire self-confidence in students	25.0	62.5	87.5
Emotional poise and self-confidence	53.3	33.3	86.6
Adequacy of self-concept	62.5	12.5	75.0

Table 3 (continued)

Item	Percent		
	Usually Important	Always Important	Total
PUBLIC SCHOOL SCIENCE SUPERVISORS			
Apparent interest in self-improvement	8.3	66.7	75.0
Interest and enthusiasm for biology	0.0	75.0	75.0
Ability to inspire self-confidence in students	9.1	63.6	72.7
Adequacy of self-concept	25.0	41.7	66.7
Emotional poise and self-confidence	8.3	58.3	66.6
Concerns for student understandings of essential concepts	16.7	41.7	58.4
Concerns for student understandings of essential science processes	16.7	41.7	58.4
Activities and accomplishments of students	25.0	33.3	58.3
STATE SCIENCE SUPERVISORS			
Ability to inspire self-confidence in students	27.8	72.2	100.0
Concerns for student understandings of essential science processes	33.3	61.1	94.4
Interest and enthusiasm for biology	41.2	52.9	94.1
Apparent interest in self-improvement	22.2	66.7	88.9
Concerns for student understandings of essential concepts	22.2	50.0	72.2
Adequacy of self-concept	44.4	27.8	72.2
Activities and accomplishments of students	33.3	33.3	66.6
Emotional poise and self-confidence	35.3	29.4	64.7

Table 3 (continued)

Item	Percent		
	Usually Important	Always Important	Total
INDUSTRIAL BIOLOGISTS			
Apparent interest in self-improvement	30.8	69.2	100.0
Emotional poise and self-confidence	41.7	58.3	100.0
Interest and enthusiasm for biology	16.7	83.3	100.0
Activities and accomplishments of students	38.5	61.5	100.0
Concerns for student understandings of essential science processes	0.0	92.3	92.3
Concerns for student understandings of essential concepts	0.0	92.3	92.3
Ability to inspire self-confidence in students	16.7	75.0	91.7
Adequacy of self-concept	58.3	16.7	75.0
COLLEGE BIOLOGISTS			
Apparent interest in self-improvement	24.5	63.3	87.8
Concerns for student understandings of essential concepts	27.1	58.3	85.4
Interest and enthusiasm for biology	22.4	61.2	83.6
Ability to inspire self-confidence in students	34.8	45.7	80.5
Emotional poise and self-confidence	45.7	32.6	78.3
Concerns for student understandings of essential science processes	23.9	54.3	78.2
Activities and accomplishments of students	34.0	25.5	59.5
Adequacy of self-concept	37.1	14.3	51.4

Table 3 (continued)

Item	Percent		
	Usually Important	Always Important	Total
COLLEGE PROFESSORS OF SCIENCE EDUCATION			
Interest and enthusiasm for biology	12.5	87.5	100.0
Concerns for student understandings of essential science processes	26.1	73.9	100.0
Apparent interest in self-improvement	16.7	79.2	95.9
Concerns for student understandings of essential concepts	21.7	73.9	95.6
Emotional poise and self-confidence	36.4	54.5	90.9
Ability to inspire self-confidence in students	13.0	69.6	82.6
Activities and accomplishments of students	29.2	50.0	79.2
Adequacy of self-concept	31.6	42.1	73.7

Biddle, Bruce J. and William J. Ellena (eds.) Contemporary Research on Teacher Effectiveness. New York: Holt, Rinehart, and Winston, 1964.

Bolton, Dale L. "Developing Criteria for Teacher Evaluation", USOE Prep Report, 21 E. Washington, D. C.; National Center for Educational Communications, 1971.

Bradley, Ruth and others. Measuring Teacher Competence: Research Backgrounds and Current Practice (Burlingame, California Teachers Association, 1964).

Brown, Bob Burton. An Investigation of Observer - Judge Ratings of Teacher Competence (Tallahassee: University of Florida, 1969).

Cicirelli, Victor G. "University Supervisors Creative Ability and Their Appraisal of Student Teacher Classroom Performance: An Exploratory Study" The Journal of Educational Research, LII April, 1969.

Cohen, Arthur M. and Florence B. Brawer. Measuring Faculty Performance (Washington: American Association of Junior Colleges, 1969).

Conant, James B. The Education of American Teachers. New York: McGraw-Hill Book Company, 1963.

Daniel, K. Fred. The Measurement and Evaluation of Teaching, A Conceptualization of a Plan for Use in State Educational Leadership (Tallahassee, Florida State Department of Education, 1967).

Dieter, Donn L. Evaluation of Biology Teachers. Unpublished Doctoral Dissertation, University of North Carolina, Chapel Hill, 1972.

"Fair Employment and Dismissal Act", North Carolina Public Schools, North Carolina Department of Public Instruction, Volume 36:4, Summer, 1972, pp 14-16.

Klinge, Paul. "In Defense of the Recognition of Merit". The American Biology Teacher. XXVII (December, 1965).

Lopez, Felix M. "Accountability in Education", Phi Delta Kappan, LII December, 1970.

Musella, Donald. "Improving Teacher Evaluation", Journal of Teacher Education, XXI Spring, 1970.

National Education Association. "Evaluation of Teaching Competence" NEA Research Bulletin, XXXVI, October, 1969.

"North Carolina Teacher Tenure Act", North Carolina Institute of Government, November 9, 1971, Paper Presented at the 1972 Principal-Teacher Evaluation Conference, University of North Carolina, Asheville, August, 1972.

Raths, Louis E. "What is a Good Teacher?" Studying Teaching, eds. James Raths, John Pancella, and J. S. Vanness, Englewood Cliffs: Prentice-Hall, 1967.

Ryans, David G. Characteristics of Teachers: Their Description, Comparison and Appraisal, Washington: American Council on Education, 1960.

Tannenbaum, Harold E., Stillman, Nathan, and Piltz, Albert, Evaluation in Elementary School Science, U. S. Department of Health, Education, and Welfare, Office of Education, U. S. Government Printing Office, Washington: 1964.

Vanhouten, William J. Laboratory and Demonstration Skills Needed To Teach Physics and Chemistry in the Secondary Schools: A Checklist and Suggested System for the Development of These Skills. Ed. D. Thesis, Teachers College, Columbia University, May, 1965.

Woodard, Robert L. "The Science Offerings, Enrollments, Facilities, and Science Teachers in the Public Secondary Schools of Upstate New York": Fall, 1958 and 1961. Ph. D. Thesis, Cornell University, September, 1963.

Yager, Robert E. "An Outstanding Biology Teacher Award Program", American Biology Teacher, XXVI March, 1964.